

What is claimed is:

1. A method of manufacturing a fan blade for rotation about an axis, the method comprising:
 - 5 providing a blade body having a front side and a back side;
 - forming an arcuate concave leading edge of the fan blade on the blade body, the arcuate concave leading edge extending along a first arcuate line;
 - forming an arcuate convex trailing edge of the fan blade on the blade body; and
 - forming an outer edge of the fan blade on the blade body, the outer edge extending
- 10 along a second line at a free end of the blade body and at least partially defining a radius of the fan blade, the first and second lines intersecting at a first point;
 - wherein the arcuate concave leading edge is formed to have a second point at a location on the arcuate concave leading edge substantially equal to 0.65 times the radius of the fan blade, and wherein an angle between a first straight line extending from the axis to the
- 15 first point and a second straight line extending from the axis to the second point is between 15 and 45 degrees.
2. The method as claimed in claim 1, wherein the angle is between 20 and 35 degrees.
- 20 3. The method as claimed in claim 1, wherein the angle is between 25 and 35 degrees.
4. The method as claimed in claim 1, wherein the arcuate concave leading edge has a camber-to-chord ratio between the first and second points of between 0 and 0.22.
- 25 5. The method as claimed in claim 1, wherein the arcuate concave leading edge is formed to have a camber-to-chord ratio between the first and second points of between 0.05 and 0.17.
6. The method as claimed in claim 1, wherein the arcuate concave leading edge is formed to have a camber-to-chord ratio between the first and second points of between 0.08 and 0.13.

7. The method as claimed in claim 1, wherein:

the arcuate convex trailing edge extends along a third arcuate line intersecting the second line at a third point;

5 the arcuate convex trailing edge is formed to have a fourth point at a location substantially equal to 0.65 times the radius of the fan blade; and

an angle defined between a third straight line extending from the axis to the third point and a fourth straight line extending from the axis to the fourth point is between 10 and 35 degrees.

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8. The method as claimed in claim 7, wherein the angle between the third and fourth straight lines is between 15 and 30 degrees.

9. The method as claimed in claim 7, wherein the angle between the third and fourth

15 straight lines is between 20 and 25 degrees.

10. The method as claimed in claim 1, wherein:

the arcuate convex trailing edge extends along a third arcuate line intersecting the second line at a third point;

20 the arcuate convex trailing edge is formed to have a fourth point at a location substantially equal to 0.65 times the radius of the fan blade; and

the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0 and 0.20.

25 11. The method as claimed in claim 10, wherein the camber-to-chord ratio is between 0.05 and 0.17.

12. The method as claimed in claim 10, wherein the camber-to-chord ratio is between 0.07 and 0.17.

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13. The method as claimed in claim 4, wherein:
 - the arcuate convex trailing edge extends along a third arcuate line intersecting the second line at a third point;
 - the arcuate convex trailing edge is formed to have a fourth point at a location substantially equal to 0.65 times the radius of the fan blade; and
 - an angle defined between a third straight line extending from the axis to the third point and a fourth straight line extending from the axis to the fourth point is between 10 and 35 degrees.
- 10 14. The method as claimed in claim 13, wherein the angle between the third and fourth straight lines is between 15 and 30 degrees.
- 15 15. The method as claimed in claim 14, wherein the angle between the third and fourth straight lines is between 20 and 25 degrees.
16. The method as claimed in claim 4, wherein:
 - the arcuate convex trailing edge extends along a third arcuate line intersecting the second line at a third point;
 - the arcuate convex trailing edge is formed to have a fourth point at a location substantially equal to 0.65 times the radius of the fan blade; and
 - the arcuate convex trailing edge has a camber-to-chord ratio between the third and fourth points of between 0 and 0.20.
- 20 17. The method as claimed in claim 16, wherein the camber-to-chord ratio between the third and fourth points is between 0.05 and 0.17.
- 25 18. The method as claimed in claim 16, wherein the camber-to-chord ratio between the third and fourth points is between 0.07 and 0.12.
- 30 19. The method as claimed in claim 7, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0 and 0.20.

20. The method as claimed in claim 7, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0.05 and 0.17.

5 21. The method as claimed in claim 7, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0.07 and 0.12.

22. The method as claimed in claim 13, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0 and 0.20.

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23. The method as claimed in claim 13, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0.05 and 0.17.

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24. The method as claimed in claim 13, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the third and fourth points of between 0.07 and 0.12.

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25. The method as claimed in claim 1, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.65 times the radius of the fan blade has a camber-to-chord ratio of between 4.0% and 7.5%.

26. The method as claimed in claim 25, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.5% and 6.5%.

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27. The method as claimed in claim 25, wherein the camber-to-chord ratio of the cross-sectional shape is between 5.0% and 6.0%.

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28. The method as claimed in claim 1, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.75 times the radius of the fan blade has a camber-to-chord ratio of between 3.5% and 7.0%.

29. The method as claimed in claim 28, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.0% and 6.0%.
- 5 30 The method as claimed in claim 28, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.5% and 5.5%.
- 10 31. The method as claimed in claim 1, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.85 times the radius of the fan blade has a camber-to-chord ratio of between 3.0% and 6.5%.
- 15 32. The method as claimed in claim 31, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.0% and 5.0%.
33. The method as claimed in claim 31, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.5% and 4.5%.
- 20 34. The method as claimed in claim 1, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.95 times the radius of the fan blade has a camber-to-chord ratio of between 2.0% and 5.5%.
- 25 35. The method as claimed in claim 34, wherein the camber-to-chord ratio of the cross-sectional shape is between 2.5% and 4.5%.
36. The method as claimed in claim 34, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.0% and 4.0%.
- 30 37. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

- providing a blade body having a front side and a back side;
forming an arcuate concave leading edge of the fan blade on the blade body;
forming an arcuate convex trailing edge of the fan blade on the blade body, the arcuate convex trailing edge extending along a first arcuate line; and
- 5 forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade, the first and second lines intersecting at a first point;
wherein the arcuate convex trailing edge is formed to have a second point at a location on the arcuate convex trailing edge substantially equal to 0.65 times the radius of the fan
- 10 blade, and wherein an angle between a first straight line extending from the axis to the first point and a second straight line extending from the axis to the second point is between 10 and 35 degrees.
38. The method as claimed in claim 37, wherein the angle is between 15 and 30 degrees.
- 15 39. The method as claimed in claim 37, wherein the angle is between 20 and 25 degrees.
40. The method as claimed in claim 37, wherein the arcuate convex trailing edge is formed to have a camber-to-chord ratio between the first and second points of between 0 and 0.20.
- 20 41. The method as claimed in claim 40, wherein the camber-to-chord ratio is between 0.05 and 0.17.
42. The method as claimed in claim 40, wherein the camber-to-chord ratio is between 0.07 and 0.12.
- 25 43. The method as claimed in claim 37, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.65 times the radius of the fan blade has a camber-to-30 chord ratio of between 4.0% and 7.5%.

44. The method as claimed in claim 43, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.5% and 6.5%.
45. The method as claimed in claim 43, wherein the camber-to-chord ratio of the cross-
5 sectional shape is between 5.0% and 6.0%.
46. The method as claimed in claim 37, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.75 times the radius of the fan blade has a camber-to-
10 chord ratio of between 3.5% and 7.0%.
47. The method as claimed in claim 46, wherein the camber-to-chord ratio of the cross-
sectional shape is between 4.0% and 6.0%.
- 15 48. The method as claimed in claim 46, wherein the camber-to-chord ratio of the cross-
sectional shape is between 4.5% and 5.5%.
49. The method as claimed in claim 37, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a
20 cross-section of the blade body taken at 0.85 times the radius of the fan blade has a camber-to-
chord ratio of between 3.0% and 6.5%.
50. The method as claimed in claim 49, wherein the camber-to-chord ratio of the cross-
sectional shape is between 3.0% and 5.0%.
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51. The method as claimed in claim 49, wherein the camber-to-chord ratio of the cross-
sectional shape is between 3.5% and 4.5%.
52. The method as claimed in claim 37, further comprising forming the blade body with a
30 concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a

cross-section of the blade body taken at 0.95 times the radius of the fan blade has a camber-to-chord ratio of between 2.0% and 5.5%.

53. The method as claimed in claim 52, wherein the camber-to-chord ratio of the cross-sectional shape is between 2.5% and 4.5%.

54. The method as claimed in claim 52, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.0% and 4.0%.

10 55. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

providing a blade body having a front side and a back side;

forming an arcuate concave leading edge of the fan blade on the blade body;

15 forming an arcuate convex trailing edge of the fan blade on the blade body, the arcuate convex trailing edge extending along a first arcuate line; and

forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade, the first and second lines intersecting at a first point;

20 wherein the arcuate convex trailing edge is formed to have a second point at a location on the arcuate convex trailing edge substantially equal to 0.65 times the radius of the fan blade, the arcuate convex trailing edge having a camber-to-chord ratio between the first and second points of between 0 and 0.20.

25 56. The method as claimed in claim 55, wherein the camber-to-chord ratio is between 0.05 and 0.17.

57. The method as claimed in claim 55, wherein the camber-to-chord ratio is between 0.07 and 0.12.

30 58. The method as claimed in claim 55, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a

cross-section of the blade body taken at 0.65 times the radius of the fan blade has a camber-to-chord ratio of between 4.0% and 7.5%.

59. The method as claimed in claim 58, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.5% and 6.5%.

60. The method as claimed in claim 58, wherein the camber-to-chord ratio of the cross-sectional shape is between 5.0% and 6.0%.

10 61. The method as claimed in claim 55, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.75 times the radius of the fan blade has a camber-to-chord ratio of between 3.5% and 7.0%.

15 62. The method as claimed in claim 61, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.0% and 6.0%.

63. The method as claimed in claim 61, wherein the camber-to-chord ratio of the cross-sectional shape is between 4.5% and 5.5%.

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64. The method as claimed in claim 55, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.85 times the radius of the fan blade has a camber-to-chord ratio of between 3.0% and 6.5%.

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65. The method as claimed in claim 64, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.0% and 5.0%.

30 66. The method as claimed in claim 64, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.5% and 4.5%.

67. The method as claimed in claim 55, further comprising forming the blade body with a concave front surface and a convex rear surface, wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.95 times the radius of the fan blade has a camber-to-chord ratio of between 2.0% and 5.5%.

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68. The method as claimed in claim 67, wherein the camber-to-chord ratio of the cross-sectional shape is between 2.5% and 4.5%.

10 69. The method as claimed in claim 67, wherein the camber-to-chord ratio of the cross-sectional shape is between 3.0% and 4.0%.

70. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

providing a blade body;

15 forming an arcuate concave leading edge of the fan blade on the blade body;

forming an arcuate convex trailing edge of the fan blade on the blade body;

forming a concave front surface on the blade body;

forming a convex rear surface on the blade body;

20 forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade;

wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.65 times the radius of the fan blade has a camber-to-chord ratio of between 4.0% and 7.5%.

25 71. The method as claimed in claim 70, wherein the camber-to-chord ratio is between 4.5% and 6.5%.

72. The method as claimed in claim 70, wherein the camber-to-chord ratio is between 5.0% and 6.0%.

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73. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

- providing a blade body;
- forming an arcuate concave leading edge of the fan blade on the blade body;
- 5 forming an arcuate convex trailing edge of the fan blade on the blade body;
- forming a concave front surface on the blade body;
- forming a convex rear surface on the blade body;
- 10 forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade;
- wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.75 times the radius of the fan blade has a camber-to-chord ratio of between 3.5% and 7.0%.

74. The method as claimed in claim 73, wherein the camber-to-chord ratio is between 15 4.0% and 6.0%.

75. The method as claimed in claim 73, wherein the camber-to-chord ratio is between 4.5% and 5.5%.

20 76. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

- providing a blade body;
- forming an arcuate concave leading edge of the fan blade on the blade body;
- 25 forming an arcuate convex trailing edge of the fan blade on the blade body;
- forming a concave front surface on the blade body;
- forming a convex rear surface on the blade body;
- forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade;
- 30 wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.85 times the radius of the fan blade has a camber-to-chord ratio of between 3.0% and 6.5%.

77. The method as claimed in claim 76, wherein the camber-to-chord ratio is between 3.0% and 5.0%.

5 78. The method as claimed in claim 76, wherein the camber-to-chord ratio is between 3.5% and 4.5%.

79. A method of manufacturing a fan blade for rotation about an axis, the method comprising:

10 providing a blade body;

forming an arcuate concave leading edge of the fan blade on the blade body;

forming an arcuate convex trailing edge of the fan blade on the blade body;

forming a concave front surface on the blade body;

forming a convex rear surface on the blade body;

15 forming an outer edge of the fan blade on the blade body, the outer edge extending along a second line at a free end of the blade body and at least partially defining a radius of the fan blade;

wherein a cross-sectional shape defined at a cross-section of the blade body taken at 0.85 times the radius of the fan blade has a camber-to-chord ratio of between 2.0% and 5.5%.

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80. The method as claimed in claim 79, wherein the camber-to-chord ratio is between 2.5% and 4.5%.

25 81. The method as claimed in claim 79, wherein the camber-to-chord ratio is between 3.0% and 4.0%.